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WHO Safety Surgical Checklist implementation evaluation in public hospitals in the Brazilian Federal District

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Summary The World Health Organization (WHO) created the WHO Surgical Safety Checklist to prevent adverse events in operating rooms. The aim of this study was to analyze WHO checklist implementation in three operating rooms of public hospitals in the Brazilian Federal District. A prospective cross-sectional study was performed with pre- (Period I) and post (Period II)-checklist intervention evaluations. A total of 1141 patients and 1052 patients were studied in Periods I and II for a total of 2193 patients. Period I took place from December 2012 to March 2013, and Period II took place from April 2013 to August 2014. Regarding the pre-operatory items, most surgeries were classified as clean-contaminated in both phases, and team attire improved from 19.2% to 71.0% in Period II. Regarding checklist adherence in Period II, ''Patient identification'' significantly improved in the stage ''Before induction of anesthesia''. ''Allergy verification'', ''Airway obstruction verification'', and ''Risk of blood loss assessment'' had low adherence in all three hospitals. The items in the stage ''Before surgical incision'' showed greater than 90.0% adherence with the exception of ''Anticipated critical events: Anesthesia team review'' (86.7%) and ''Essential imaging display'' (80.0%). Low adherence was noted in ''Instrument counts'' and ''Equipment problems'' in the stage ''Before patient leaves operating room''. Complications and deaths were low in both periods. Despite the variability in checklist item compliance in the surveyed hospitals, WHO checklist implementation

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as an intervention tool showed good adherence to the majority of the items on the list. Nevertheless, motivation to use the instrument by the surgical team with the intent of improving surgical patient safety continues to be crucial.

Introduction

Errors and surgical adverse events (AEs) require the development of effective preventive measures that promote patient safety. Data from 56 countries showed that 234 million major surgeries were performed every year [1], resulting in seven million postoperative complications (50.0% of which could be avoided) and one million deaths [1,2]. In developed countries, complications in major surgical practices range from 3.0% to 16.0% with a mortality rate that ranges from 0.4% to 0.8% (compared to 5.0% to 10.0% in developing countries) [2].

In the United States, one AE is estimated to occur in every 50,000 to 100,000 surgical procedures, which results in 1500—2500 incidents/year [2—4]. More than 70.0% of the 126 AE cases in the United States were wrong-site surgery, 13.0% were the wrong patient, and 11.0% involved the wrong procedure [2]. In Brazil, few studies have assessed the magnitude of surgical AEs. Mendes et al. [5] reported a incidence of 7.6% (84 of 1103 patients) for AEs in three public hospitals in Rio de Janeiro, of which 66.7% were preventable.

Given the scale of the surgical AE problem, the WHO created the Surgical Safety Checklist with possible adaptation for local services [2]. Analyses of the use of the WHO checklist (i.e., Haynes et al.'s [6] multicenter study conducted with 7688 patients) showed a reduction in major complications from 11.0% to 7.0%, representing a 36.0% drop ($p < 0.001$), and a 47.0% decrease in mortality (from 1.0% to 0.8%; $p = 0.03$). Askarian et al. [7] observed a reduction in AEs from 22.9% to 10.0% in a teaching hospital in Iran. In Norway in 2014, a reduction in complications from 19.9% to 11.5% ($p < 0.001$) and a reduction in deaths from 1.9% to 0.2% ($p = 0.020$) were reported out of 2212 surgical procedures that did not use the checklist and 2263 cases that adopted that tool in one of the two hospitals studied [8].

In Brazil, an observational and cross-sectional study performed in 2012 in two hospitals in the state of Rio Grande do Norte by Freitas et al. [9] reviewed the implementation of the WHO checklist in 375 surgeries and found that 61.0% used the checklist; however, only 4.0% of the checklists were filled out completely. According to the authors, adherence to the tool needs to be improved to raise awareness among surgeons about the importance of its use.

Since 2009, Ferraz [10] has stressed the need to enhance surgical safety. In 2013, the Brazilian Ministry of Health (MoH) created the National Patient Safety Program to reinforce the importance of surgical safety [11,12].

A pilot study on the implementation of the WHO checklist was developed in public hospitals in the Federal District to map strategies for adoption by other health facilities in Brazil. This study analyzed the results of the implementation of the checklist in three public hospitals in the Brazilian Federal District.

Material and methods

Study design

This study is a prospective cross-sectional study comprising a pre- and post-intervention evaluation of the WHO checklist. The inclusion criteria were: elective surgeries and patients at least 18 years of age. The following surgeries were excluded: outpatient, pediatric and cardiac surgeries (due to the seriousness of the patient's condition and/or the stress of the team/patient, especially in surgeries with cardiopulmonary bypasses), surgical emergencies, and surgeries with implants and prostheses (due to the need for lengthy post-operative follow up, which would make data collection related to the occurrence of infection more difficult). The same inclusion and exclusion criteria were applied to the pre- and post-intervention phases.

Table 1 Features of public hospitals participating in the study — Federal District, 2015.

Features	Hospital 1	Hospital 2	Hospital 3
Type	Public	Public	Public
No. of beds	748	299	226
No. of surgical beds[a]	482	68	72
No. of operating rooms	16	10	5
No. of surgeries per year[b]	7267	2905	3695

[a] National Health Facilities Census (CNES), 2015.
[b] Ambulatory Information System (SIASUS), 2014.

Settings

The study was conducted in three public hospitals in the Brazilian Federal District from December 2012 to August 2014 (Table 1).

Data collection and intervention

The pre-intervention phase (Period I) took place from December 2012 to March 2013. The following data were collected through direct observation by the researcher: demographics, hospital stay data, classification and duration of surgery, type of anesthesia, trichotomy (time and equipment), surgical hand antisepsis, surgical attire, surgical drainage, surgical specialties and postoperative complications. Complications were considered to be cardiac arrest requiring cardiopulmonary resuscitation, unplanned intubation, use of a ventilator for 48 h or more, pneumonia, wound dehiscence, sepsis, unplanned return to the operating room (OR), surgical site infection (SSI), urinary retention, and death [2,6,13].

The intervention consisted of two phases: (1) surgical team training (surgeons, anesthetists, and nursing team) in the three hospitals to improve checklist use, which was conducted by experts in surgery and health surveillance with a workload of 18 h and technical materials provided by the WHO [2] and (2) WHO checklist implementation. Afterwards, the Period II survey (post-intervention) was conducted. During this period, the checklist was applied by a trained researcher who participated directly with the surgical teams from April 2013 to August 2014. The same data described for Period I were collected in addition to the checklist data (Table 2). The study relied on the participation of all of the professionals (surgeons, anesthetists, nursing team, Hospital Infection Control Committee (HICC), and quality risk management) in the checklist training. Although the training was not mandatory, the heads of services signed an agreement to train their staff and implement the checklist in their institutions. The data collection instrument was applied in both phases by trained researchers (nurses) without any employment relationship with the participating hospitals.

Data concerning complications and readmissions due to surgery-related problems were collected for up to 30 days post-surgery. For the SSI surveillance, we collected information from the HICC, a review of the discharged patient records, microbiological tests, wound assessment, and patient information via phone. SSI identification used the diagnostic criteria defined by ANVISA [13] based on the CDC's guidelines [14]. The review of cases with complications and deaths had the full support of surgeons with experience in infection control.

Table 2 Constant variables in the Surgical Safety Checklist[a].

Checklist
Before induction of aesthesia (Sign in)
Item 1 — Patient identification
Item 2 — Surgical site demarcation
Item 3 — Pulse oximeter placement
Item 4 — Pulse oximeter functioning
Item 5 — Allergy verification
Item 6 — Airway obstruction verification
Item 7 — Risk of blood loss assessment
Before skin incision (Time out)
Item 8 — Surgical team member introduction
Item 9 — Surgical team verbally confirms patient data
Item 10 — Anticipated critical events: Surgeon review
Item 11 — Anticipated critical events: Anesthesia team review
Item 12 — Anticipated critical events: Nursing team review
Item 13 — Antibiotic prophylaxis
Item 14 — Essential imaging display
Before patient leaves operating room (Sign out)
Item 15 — Name of the procedure is recorded
Item 16 — Instrument count
Item 17 — Specimen labeling
Item 18 — Equipment problems
Item 19 — Patient recovery and patient management review

[a] Based on the WHO Surgical Safety Checklist [2].

The sample size was calculated to detect a 20.0% reduction in the probability of a complication in the treatment group (post-intervention) compared with the control group (pre-intervention) assuming a 0.05 level of statistical significance (alpha value) and 80.0% probability of correctly rejecting the hypothesis that there was no difference between the proportions of post-surgical complications between groups.

Data analysis

Fisher's exact test was used to compare the sample proportions per group and identify differences between profiles.

The software SPSS for Windows, version 11.5 (Chicago, Illinois, USA, SPSS Inc.) was used for the analysis. Proportions of checklist items were calculated (pre- and post-intervention) within hospitals, taking into consideration the total number of observations. The nonparametric Kruskal—Wallis and Mann—Whitney tests were used to compare the pre- and post-intervention phases with a significance level of 5.0%. A Pareto chart was used to identify the items in the checklist with low adherence.

Results

The characteristics of the 2193 patients are shown in Table 3, including 1141 patients in Period I (pre-intervention) and 1052 patients in Period II (post-intervention). The average ages of the patients in the pre- and post-intervention phases were 47.2 years and 49.4 years, respectively. Most of the patients in both phases were female (64.9% and 62.0%, respectively).

Most surgeries in both phases were classified as clean-contaminated (56.9% and 49.8%, respectively). General anesthesia was predominant in both phases (46.8% and 49.7%, respectively). The average stay was less than 15 days for 82.8% of the patients in Period I and 88.0% of the patients in Period II, with a significant reduction of stay after intervention for those with more than 15 days of hospitalization (Table 3).

Table 4 shows four important measures for the prevention of SSI that were evaluated in this study: hair removal using razor blades was performed in approximately 20% of the surgeries and occurred more than 2 h before the surgery in 70% of the cases in both phases (except in Hospital 2); surgical hand antisepsis was performed by all surgeons and improved in all three hospitals (10.2%); and surgical attire, which improved from 19.2% to 71.0%, with special attention to Hospital 3, which presented 100% ''incomplete'' (when any one of the items that should be used during the surgical procedure was not used, such as sterile aprons, sterile gloves, masks, shoe covers, caps, or goggles) in Period I and improved to 69.8% ''complete'' in Period II. The most common surgical specialties in both periods were general ($n = 877$), urology ($n = 301$), mastology ($n = 278$) and gynecology ($n = 223$) (Table 4), with median lengths of stay of 2.0, 6.0, 2.0 and 3.0 days, respectively.

Table 5 displays adherence to the checklist data in Period II (post-intervention) after the completion of each item. In the first stage (Before induction of anesthesia), we noted that Item 1 (Patient identification) improved significantly in the three hospitals; the same cannot be said for Item 2 (Surgical site confirmation), which had average adherence rates lower than 25%. The adherence for Item 3 (Pulse oximeter placement) and Item 4 (Pulse oximeter functioning) was higher than 95%. Item 5 (Allergy verification), Item 6 (Airway obstruction verification) and Item 7 (Risk of blood loss assessment) had low adherence in all three hospitals.

All items in the stage ''Before surgical incision'' showed adherences higher than 90%, except for Item 11 (Anticipated critical events: Anesthesia team review) and Item 14 (Essential imaging display), which had average adherence rates of 86.7% and 80.0%, respectively.

In the stage ''Before patient leaves OR'', the low adherence to ''Instrument count'' (Item 16) in Hospital 2 and ''Equipment problems'' (Item 18) in Hospitals 2 and 3 is noteworthy.

When all three hospitals are taken into consideration, 70% of the adherence problems referred to Items 2, 5, 6, and 7 as shown by the Pareto charts in Fig. 1(a—d).

The frequency of surgical complications was low in both phases, with SSI (2.0%) in the pre-intervention phase, unplanned return to the OR (1.4%), and wound dehiscence (1.1%) standing out. Other complications (cardiac arrest, unplanned intubation, use of ventilator for 48 h or more, pneumonia, sepsis, urinary retention, and death) accounted for 1.0%. In the post-intervention phase, none of the complications mentioned reached 1.0% of the cases. No significant changes in the distribution of the percentages of complications were observed in either phase.

Discussion

Considering the low adherence to items in different stages of the WHO Surgical Safety Checklist

Table 3 Patient and surgical procedure characteristics according to checklist intervention phase (Period I — Pre and Period II — Post), in hospitals in the Federal District. Brazil, 2012—2014.

Patient and surgical procedure characteristics	Hospital 1				Hospital 2				Hospital 3				Total			
	Period I		Period II		Period I		Period II		Period I		Period II		Period I		Period II	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Number of surgeries	516	100.0	526	100.0	348	100.0	229	100.0	277	100.0	297	100.0	1141	100.0	1052	100.0
Sex																
Male	225	44.9	206	40.6	91	27.8	55	27.4	53	23.7	119	40.9	369	35.1	380	38.0
Female	276	55.1	302	59.4	236	72.2	146	72.6	171	76.3	172	59.1	683	64.9	620	62.0
Total	501	100.0	508	100.0	327	100.0	201	100.0	224	100.0	291	100.0	1052	100.0	1000	100.0
p-Value[a]	0.162				0.908				<0.001				0.169			
Age group																
18—29	62	12.5	31	6.3	31	9.7	27	13.4	27	12.2	29	10.2	120	11.6	87	8.9
30—39	69	13.9	80	16.1	92	28.9	46	22.9	50	22.5	59	20.7	211	20.4	185	18.8
40—49	84	17.0	103	20.8	87	27.4	50	24.9	55	24.8	71	24.9	226	21.8	224	22.8
50—59	89	18.0	107	21.6	68	21.4	45	22.4	32	14.4	49	17.2	189	18.3	201	20.5
60+	191	38.6	175	35.3	40	12.6	33	16.4	58	26.1	77	27.0	289	27.9	285	29.0
Total	495	100.0	496	100.0	318	100.0	201	100.0	222	100.0	285	100.0	1035	100.0	982	100.0
p-Value[a]	0.744				0.482				0.395				0.072			
Surgery classification																
Clean	217	43.4	228	44.9	40	12.2	30	15.0	104	46.0	166	57.2	361	34.3	424	42.5
Clean-contaminated	220	44.0	238	46.9	264	80.5	153	76.5	116	51.3	106	36.6	600	56.9	497	49.8
Contaminated	38	7.6	31	6.1	24	7.3	16	8.0	4	1.8	15	5.2	66	6.3	62	6.2
Dirty	25	5.0	11	2.2	0	—	1	0.5	2	0.9	3	1.0	27	2.6	15	1.5
Total	500	100.0	508	100.0	328	100.0	200	100.0	226	100.0	290	100.0	1054	100.0	998	100.0
p-Value[a]	0.147				0.291				<0.001				0.007			
Surgery duration																
Less than 30 min	1	0.3	0	0.0	12	3.7	2	1.3	9	5.5	0	0.0	22	2.8	2	0.3
30—59 min	1	0.3	0	0.0	53	16.4	2	1.3	17	10.4	0	0.0	71	9.1	2	0.3
60 min or more	294	99.3	309	100.0	259	79.9	145	97.3	137	84.0	155	100.0	690	88.1	609	99.3
Total	296	100.0	309	100.0	324	100.0	149	100.0	163	100.0	155	100.0	783	100.0	613	100.0

p-Value[a]	0.148				<0.001				<0.001				<0.001			
Type of anesthesia																
General anesthesia	287	55.6	324	61.6	185	53.2	108	47.2	62	22.4	91	30.6	534	46.8	523	49.7
p-Value[a]	0.500	0.159	0.025	0.173												
Regional anesthesia	153	29.7	155	29.5	98	28.2	63	27.5	108	39.0	125	42.1	359	31.5	343	32.6
p-Value[a]	0.948	0.865	0.450	0.567												
Epidural anesthesia	59	11.4	109	20.7	42	12.1	44	19.2	18	6.5	41	13.8	119	10.4	194	18.4
p-Value[a]	<0.001				0.018				0.004				<0.001			
Local anesthesia	83	16.1	70	13.3	27	7.8	18	7.9	42	15.2	55	18.5	152	13.3	143	13.6
p-Value[a]	0.206				0.965				0.284				0.852			
Other type of anesthesia	15	2.9	11	2.1	20	5.7	13	5.7	32	11.6	30	10.1	67	5.9	54	5.1
p-Value[a]	0.399				0.972				0.576				0.449			
Length of stay																
<3 days	88	19.4	133	29.7	125	65.4	106	67.9	145	68.4	143	61.6	358	41.8	382	45.7
3–7 days	163	35.9	197	44.0	54	28.3	36	23.1	52	24.5	59	25.4	269	31.4	292	34.9
8–15 days	77	17.0	53	11.8	6	3.1	5	3.2	7	3.3	18	7.8	90	10.5	76	9.1
16 or longer	126	27.8	65	14.5	6	3.1	9	5.8	8	3.8	12	5.2	140	16.3	86	10.3
Total	454	100.0	448	100.0	191	100.0	156	100.0	212	100.0	232	100.0	857	100.0	836	100.0
p-Value[a]	<0.001				0.796				0.084				0.004			

[a] *p*-Value calculated with Mann–Whitney test to compensate the distribution difference in phases 1 and 2. — No observation.

Table 4 Pre-operatory control item assessment and specialties according to checklist intervention period (Period I — Pre and Period II — Post) by hospital in the Federal District. Brazil, 2012—2014.

Infection prevention procedures and specialties	Hospital 1				Hospital 2				Hospital 3				Total			
	Period I		Period II		Period I		Period II		Period I		Period II		Period I		Period II	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Number of surgeries	516	100.0	526	100.0	348	100.0	229	100.0	277	100.0	297	100.0	1141	100.0	1052	100.0
Trichotomy																
With clipper	1	0.2	0	—	4	1.2	0	—	0	—	4	1.4	5	0.5	4	0.4
With razor blade	118	23.5	119	23.3	49	14.8	35	17.3	80	35.4	40	13.7	247	23.3	194	19.3
No removal	58	11.5	14	2.7	2	0.6	0	0.0	42	18.6	9	3.1	102	9.6	23	2.3
Not applicable	326	64.8	377	73.9	276	83.4	167	82.7	104	46.0	238	81.8	706	66.6	782	78.0
Total	503	100.0	510	100.0	331	100.0	202	100.0	226	100.0	291	100.0	1060	100.0	1003	100.0
p-Value[a]	0.015				0.857				<0.001				<0.001			
Trichotomy interval																
2 h or more before the surgical procedure	116	98.3	118	99.2	3	5.8	7	20.0	55	68.8	25	56.8	174	69.6	150	75.8
Less than 2 h before the surgical procedure	2	1.7	1	0.8	49	94.2	28	80.0	25	31.3	19	43.2	76	30.4	48	24.2
Total	118	100.0	119	100.0	52	100.0	35	100.0	80	100.0	44	100.0	250	100.0	198	100.0
p-Value[a]	0.557				0.042				0.186				0.148			
Surgical hand antisepsis																
Not performed	0	—	0	—	1	0.3	0	—	1	0.4	0	—	2	0.2	0	—
Performed only by professionals	5	1.0	0	—	33	10.1	3	1.5	78	34.5	18	6.2	116	11.0	21	2.1
Performed by all professionals	496	99.0	510	100.0	293	89.6	195	98.5	147	65.0	273	93.8	936	88.8	978	97.9
Total	118	100.0	119	100.0	52	100.0	35	100.0	80	100.0	44	100.0	250	100.0	198	100.0
p-Value[a]	0.024				<0.001				<0.001				<0.001			
Team attire																
Complete for only part of the professionals	190	37.8	17	3.3	301	91.2	174	87.4	0	—	2	0.7	491	46.4	193	19.3
Complete for all professionals	180	35.9	481	94.5	23	7.0	25	12.6	0	—	203	69.8	203	19.2	709	71.0
Incomplete	132	26.3	11	2.2	6	1.8	0	0.0	226	100.0	86	29.6	364	34.4	97	9.7
Total	501	100.0	510	100.0	327	100.0	198	100.0	226	100.0	291	100.0	1054	100.0	999	100.0

p-Value[a]	0.001				0.193				<0.001				0.056			
Surgical drainage																
With closed system	490	97.8	506	99.6	74	22.4	49	25.7	115	50.9	98	34.3	679	64.2	653	66.3
Not performed	8	1.6	0	—	0	—	2	1.0	25	11.1	4	1.4	33	3.1	6	0.6
Not applicable	3	0.6	2	0.4	249	75.5	135	70.7	34	15.0	169	59.1	286	27.1	306	31.1
Other (specify)	0	—	0	—	7	2.1	5	2.6	52	23.0	15	5.2	59	5.6	20	2.0
Total	502	100.0	509	100.0	330	100.0	199	100.0	226	100.0	291	100.0	1058	100.0	999	100.0
p-Value[a]	0.011				0.375				0.030				0.260			
Specialties																
Head and Neck	50	9.7	59	11.3	21	6.2	15	6.6	1	0.4	0	0.0	72	6.4	74	7.1
General	138	26.8	198	38.0	132	39.1	108	47.2	136	49.3	165	55.6	406	36.0	471	45.0
Gynecology	16	3.1	26	5.0	62	18.3	42	18.3	48	17.4	29	9.8	126	11.2	97	9.3
Mastology	88	17.1	86	16.6	29	8.6	24	10.5	29	10.5	22	7.4	146	12.9	132	12.6
Nephrology	2	0.4	10	1.9	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2	10	1.0
Ophthalmology	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0
Otorhinolaringology	16	3.1	13	2.4	19	5.6	8	3.5	0	0.0	0	0.0	35	3.1	21	2.0
Plastic	12	2.3	6	1.2	16	4.7	3	1.3	9	3.3	23	7.7	37	3.3	32	3.1
Pulmonology	27	5.3	0	0.0	8	2.4	0	0.0	0	0.0	0	0.0	35	3.1	0	0.0
Proctology	22	4.3	17	3.3	10	3.0	6	2.6	11	4.0	4	1.3	43	3.8	27	2.6
Thoracic	17	3.3	6	1.2	5	1.5	0	0.0	0	0.0	0	0.0	22	2.0	6	0.6
Urology	105	20.4	97	18.6	35	10.4	22	9.6	20	7.2	22	7.4	160	14.2	141	13.5
Vascular	21	4.1	3	0.6	0	0.0	1	0.4	22	8.0	32	10.8	43	3.8	36	3.4
Total	514	100.0	521	100.0	338	100.0	229	100.0	276	100.0	297	100.0	1128	100.0	1047	100.0
p-Value[a]	<0.001				<0.001				0.048				0.005			

[a] *p*-Value calculated with Mann—Whitney test to compensate the distribution difference in Periods I and II. — No observation.

Table 5 Safety items marked on the checklist for Period II in hospitals in the Federal District. Brazil, 2012—2014.

Safety items in checklist stages[a]	Hospital 1		Hospital 2		Hospital 3		Total	
	No.	%	No.	%	No.	%	No.	%
Number of surgeries	526	100.0	229	100.0	297	100.0	1052	100.0
Item 1								
Yes	488	92.8	180	78.6	280	94.3	948	90.1
No	38	7.2	49	21.4	17	5.7	104	9.9
Total	526	100.0	229	100.0	297	100.0	1052	100.0
Item 2								
Yes	108	22.6	45	35.2	48	20.0	201	23.8
No	370	77.4	83	64.8	192	80.0	645	76.2
Total	478	100.0	128	100.0	240	100.0	846	100.0
Item 3								
Yes	503	99.6	197	97.5	286	100.0	986	99.3
No	2	0.4	5	2.5	0	—	7	0.7
Total	505	100.0	202	100.0	286	100.0	993	100.0
Item 4								
Yes	504	99.2	196	97.5	286	100.0	986	99.1
No	4	0.8	5	2.5	0		9	0.9
Total	508	100.0	201	100.0	286	100.0	995	100.0
Item 5								
Yes	67	13.2	29	14.5	49	17.1	145	14.6
No	441	86.8	171	85.5	238	82.9	850	85.4
Total	508	100.0	200	100.0	287	100.0	995	100.0
Item 6								
Yes	32	6.3	22	11.3	45	15.6	99	10.0
No	474	93.7	173	88.7	244	84.4	891	90.0
Total	506	100.0	195	100.0	289	100.0	990	100.0
Item 7								
Yes	58	11.4	70	34.8	22	7.6	150	15.0
No	451	88.6	131	65.2	267	92.4	849	85.0
Total	509	100.0	201	100.0	289	100.0	999	100.0
Item 8								
Yes	479	94.5	184	91.1	255	88.2	918	92.0
No	28	5.5	18	8.9	34	11.8	80	8.0
Total	507	100.0	202	100.0	289	100.0	998	100.0
Item 9								
Yes	503	99.4	188	93.1	282	97.9	973	97.7
No	3	0.6	14	6.9	6	2.1	23	2.3
Total	506	100.0	202	100.0	288	100.0	996	100.0
Item 10								
Yes	503	99.6	182	91.5	245	84.8	930	93.7
No	2	0.4	17	8.5	44	15.2	63	6.3
Total	505	100.0	199	100.0	289	100.0	993	100.0
Item 11								
Yes	501	99.4	117	59.4	242	83.7	862	86.7
No	3	0.6	80	40.6	47	16.3	132	13.3
Total	504	100.0	197	100.0	289	100.0	994	100.0
Item 12								
Yes	503	99.8	201	100.0	287	99.3	991	99.7
No	1	0.2	0	—	2	0.7	3	0.3
Total	504	100.0	201	100.0	289	100.0	994	100.0

Table 5 (*Continued*)

Safety items in checklist stages[a]	Hospital 1		Hospital 2		Hospital 3		Total	
	No.	%	No.	%	No.	%	No.	%
Item 13								
Yes	505	99.8	172	98.9	223	96.5	900	98.8
No	1	0.2	2	1.1	8	3.5	11	1.2
Total	506	100.0	174	100.0	231	100.0	911	100.0
Item 14								
Yes	491	97.0	149	74.1	156	54.2	796	80.0
No	15	3.0	52	25.9	132	45.8	199	20.0
Total	506	100.0	201	100.0	288	100.0	995	100.0
Item 15								
Yes	501	99.4	3	1.6	248	85.2	752	76.1
No	3	0.6	190	98.4	43	14.8	236	23.9
Total	504	100.0	193	100.0	291	100.0	988	100.0
Item 16								
Yes	500	98.4	4	2.0	197	67.7	701	70.2
No	8	1.6	195	98.0	94	32.3	297	29.8
Total	508	100.0	199	100.0	291	100.0	998	100.0
Item 17								
Yes	450	100.0	139	97.9	163	96.4	752	98.8
No	0	—	3	2.1	6	3.6	9	1.2
Total	450	100.0	142	100.0	169	100.0	761	100.0
Item 18								
Yes	470	92.9	26	13.8	9	3.1	505	51.4
No	36	7.1	163	86.2	279	96.9	478	48.6
Total	506	100.0	189	100.0	288	100.0	983	100.0
Item 19								
Yes	506	100.0	4	2.0	277	95.8	787	79.2
No	0	0.0	195	98.0	12	4.2	207	20.8
Total	506	100.0	199	100.0	289	100.0	994	100.0

[a] Indicated in Table 2.

reported by other authors [15,16], good levels of compliance for most of the checklist items were reported in this study after the implementation of the checklist, showing a positive initiative for patient safety.

In the first stage of the checklist (Before induction of anesthesia), the 90% adherence to Item 1 (Patient identification) represented quality improvement and was in accordance with the findings of other authors. Biffl et al. [17] studied adherence to the Surgical Safety Checklist items in 10 hospitals in Colorado (USA) in 850 surgeries (elective, urgent, and emergency) and found that compliance with the items in this stage was better (especially Item 1) with 95.0—99.0% adherence. Considerable levels of verification for Item 1 (94.3%) were also observed in Freitas et al.'s [9] study. During the present study, one of the hospitals adopted wristbands for patient identification, which may have influenced the improvement of this result.

The poor adherence to ''Surgical site demarcation'' (Item 2) in this study can be attributed to the exclusion of orthopedic surgeries with implant/prosthesis in which the demarcation of the surgical site is essential. Additionally, the instrument needed to perform the surgical site demarcation was not available during part of the study. Similar to the present study, Kasatpibal et al. [18] evaluated 4340 patients who underwent surgical procedures in Thailand and showed reduced compliance with surgical site demarcation (19.4%). Khorshidifar et al. [19] reported 24% adherence in two hospitals in Tehran. Seiden and Barach [6] analyzed multiple databases in search of AEs with the wrong patient, wrong site, wrong side, and wrong procedure surgeries and identified 5940 records in which demarcation before the surgery was performed

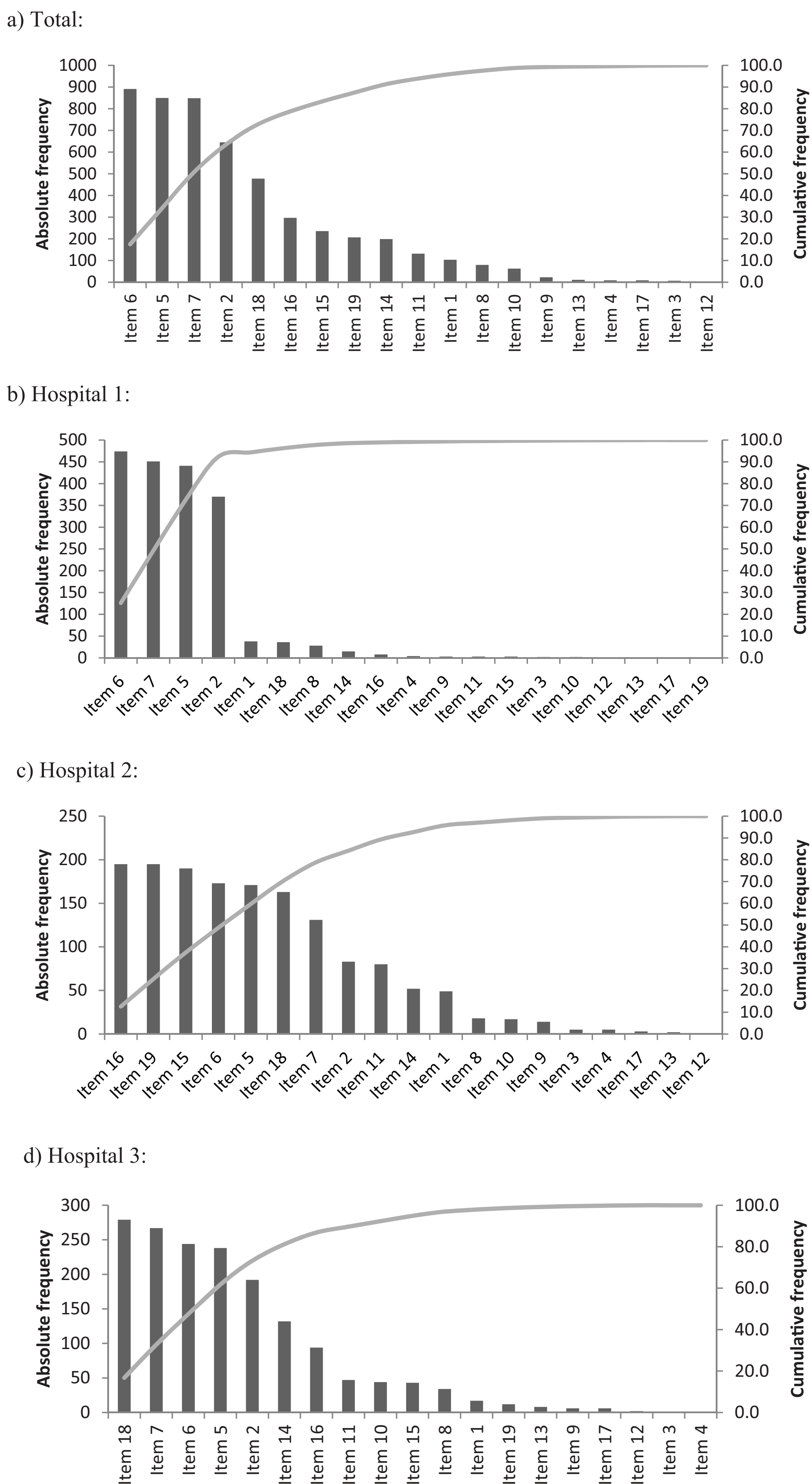

Figure 1 Pareto chart for the least frequently adhered to items in relation to the total and per hospital in the Federal District. Brazil, 2012—2014.

with only 24.0% of the patients. In a pediatric hospital in Argentina, surgical site demarcation was performed in 56.0% of the cases [20]. Adherence to surgical site checking was also considered low in the work of Garnerin et al. [21] (32.2—52.0%).

The hospitals already systematically used signal processing methods for pulse oximetry, resulting in adherence superior to 99% for Items 3 and 4. ''Risk of blood loss assessment'' (Item 7) was observed in only 15% of the cases in this study. This finding shows that the surgical teams need to give more importance to this item.

There was satisfactory compliance with safety items (Items 8—13) in the stage ''Before skin incision'', including the administration of antibiotic prophylaxis within the last 60 min. The initial part of this stage is important to facilitate communication between professionals [2]. Adequate levels of confirmation were seen in Item 8 (Surgical team member introduction) during this stage. The high level of confirmation of this item in our study may have been supported by the use of boards hanging on the OR walls indicating the names of the surgical team members in addition to other information. The low adherence (54.2%) to Item 14 (Essential imaging display) in Hospital 2 was similar to that found by Freitas et al. [9] (i.e., 54.0% in all of the surgeries assessed in the study) and by Kasatpibal et al. [18] (64.4%).

In general, adherence to the items that pertained to the last stage (Before patient leaves the OR) was inferior to the adherence in the first two stages and ranged from 51.4% on Item 18 (Equipment problems) to 98.8% on Item 17 (Specimen labeling). The high occurrence of issues related to insufficient equipment problem checks (Item 18) at this stage drew our attention. The checklist coordinator should ensure that equipment problems that have occurred during surgery are identified, reported, and documented by the team [2]. In Khorshidifar et al.'s study [19], the lowest adherence to the checklist items was related to equipment problem checking. The results of our study suggest that the need for a better understanding of the importance of this item for the safety of the surgical teams is essential despite the existence of difficulties observed in the substitution and the maintenance of hospital equipment.

Low adherence to Item 16 (Instrument count) involving swab, sponge, and needle counts was observed in Hospital 2. In procedures in which the count was performed, it was finalized and checked when the patient was no longer in the OR in 80.0% (n = 16) of the cases, which was contrary to the recommendations of the checklist [2]. These findings highlight a fundamental need for the surgical teams to be made aware of the importance of checking this item on the checklist. Hospital 2 showed a great weakness in Item 19 (Patient recovery and patient management review), which brought the average of the three hospitals down. Nugent et al. [22] reported that Item 19 was one of the most omitted items from the list (38.0%) in Ireland and was probably affected by reduced interdisciplinary communication, similar to the situation in the Brazilian Federal District. The surgeon, anesthesiologist, and nurse must review the postoperative recovery plan, especially focusing on anesthetic or surgical issues that may interfere with patient recovery [2]. In the checklist run through in this study, we noted that some members of the surgical teams did not respond to or confirm these items orally when asked. This discrepancy may be due to the rotation of residents/interns; however, checklist training for the new residents/interns was conducted by faculty members. Studies are needed to investigate ways to improve and sustain surgical team member compliance with the checklist, which would increase its acceptance, especially in teaching hospitals in developing countries.

In the context of this study, hair removal was routinely performed in the hospitals with a significant reduction between the periods investigated. However, most of the procedures used razor blades and not electric clippers as recommended by the WHO [2] and CDC [14]. This discrepancy may have been due to a lack of clippers in the hospitals studied. Another non-compliance issue was the 2 h or longer gap between hair removal and surgery [2,14], which may have occurred as a result of a lack of attention to or the failure to follow SSI prevention protocols by the surgical teams. ''Complete'' team attire (aprons, gloves, masks, shoe covers, caps, and goggles or protective masks) by all professionals on duty improved from 19.2% to 71.0%. Surgeon hand antisepsis presented improvement between the two periods and was performed by most professionals. The results of the evaluations of team attire and surgical hand antisepsis may reflect the possibility that these procedures are already routine practices in the surveyed facilities. The prevalence of clean-contaminated surgeries during Periods I and II can be explained by the high frequency of gynecological and digestive tract surgeries in this study. Surgical drainage was used in most of the cases [14] with a closed system in both periods.

The significant reduction in the hospital stay after the intervention reflects the importance of raising the awareness of surgical teams to improve the quality of surgical care.

In this study, there was no significant reduction in the rates of surgical complications or deaths.

Similarly, other studies, such as Sewell et al. [23] in England and Urbach et al. [24] in Canada, have shown no drop in surgical complications or mortality. Bergs et al. [25] performed a meta-analysis to assess the association between efficacy and adherence to the WHO Checklist and concluded that there was evidence of a reduction of both events; however, this finding could not be considered definitive due to a lack of more substantial studies. In the present study, the finding that some of the hospitals did not have systematic monitoring of post-discharge surgical patients as recommended by the CDC [14,26] may have contributed to the underreporting of SSIs. Routine post-discharge SSI follow-up by the HICC, audits, and ongoing training can optimize infection prevention and control and improve adherence to and the use of the checklist by surgical teams.

A limitation of this study is the possible biases inherent to the prospective design (pre- and post-intervention) and the selection bias that excluded emergency surgeries, surgeries with implants and prosthetics (especially orthopedic procedures and plastic surgeries with prostheses due to the inability to follow up for one year after the surgery), and more complex surgeries, such as cardiac surgeries with cardiopulmonary bypasses. The differences in compliance observed in some of the safety checklist items in the hospitals in this study may have occurred due to the hospital type, the diversity of specialties, and the characteristics of the surgical teams and patients. There was a delay in data collection during Period II due to the World Cup (which was held in Brazil and resulted in dropouts and cancelations of surgeries), a change in the researcher, the need for training, and some refusals to apply the checklist (surgeon/patient). The fact that the professionals were aware that they were being observed might have contributed to behavior changes (also known as the Hawthorne effect) [27]. Additionally, Brazilian laws on patient safety were established during the study [11,12], most likely resulting in better assimilation and conformity of certain safety items by the surgical teams.

Conclusions

Despite the variation in checklist item compliance in the surveyed hospitals, the implementation of the WHO checklist as an intervention tool in this study showed good compliance for most items. However, some security items were neglected despite the presence of researchers in the ORs as checklist coordinators during the procedures and should be reinforced with frequent supervision during checklist training programs.

Managerial attention should be given to the items with greater adherence problems in each facility. To improve adherence to the WHO checklist in the evaluated health services, the following actions are suggested: managers need to guarantee necessary supplies for the application of the checklist in hospitals; the performance of all of the members of the surgical teams should be supervised in regards to the checklist and include periodic feedback; permanent training should be provided for checklist implementation, especially for those items that showed lower levels of adherence; and local requirements and motivation to use the instrument by the surgical teams should be updated with the intent to improve surgical patient safety.

Qualitative studies should be conducted to improve the understanding of the reasons for the variable adherence to the checklist items.

Our findings may help guide the decision-making process of managers and health officials in the implementation of the Surgical Safety Checklist in surgical centers in Brazil. Moreover, our results can support decision-making for recommendations and regulations on surgical safety by ANVISA.

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Competing interests

None declared.

Ethical approval

The study was approved by the Ethics Committee of the University of Brasilia (UnB), Opinion No. 185/12.

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